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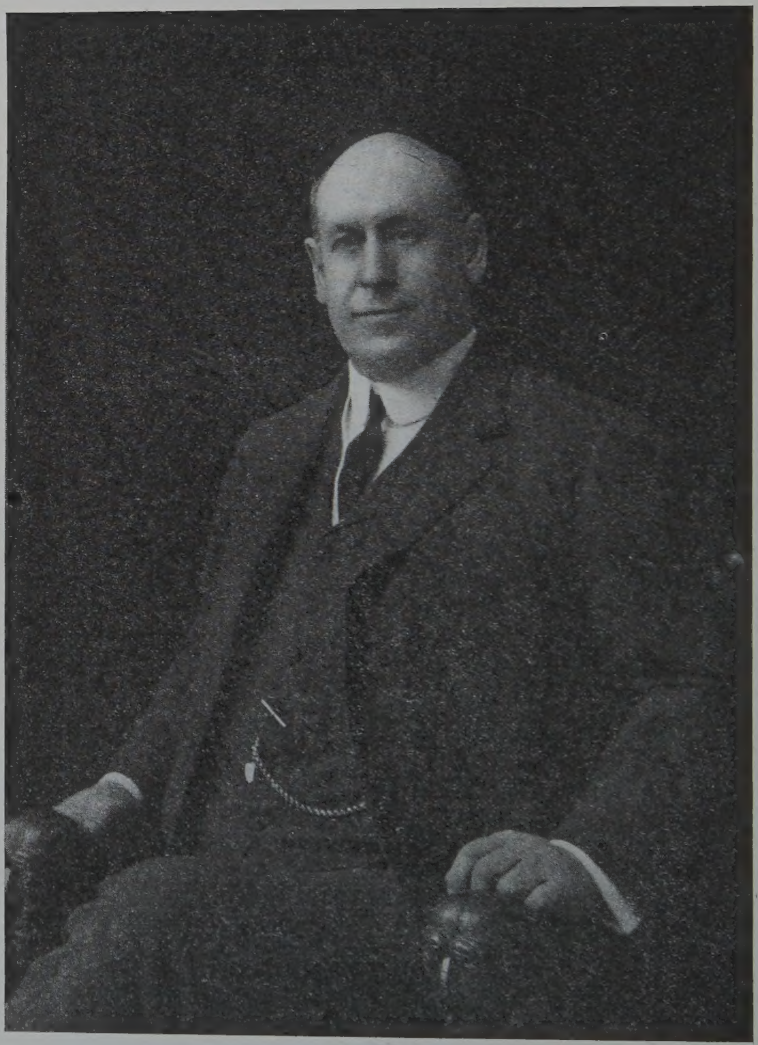

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President, Boston Society of Civil Engineers,
1914 – 1915.

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Vol. II MARCH, 1915 No. 3

BOSTON SOCIETY OF CIVIL ENGINEERS
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PROCEEDINGS

SIXTY-SEVENTH ANNUAL MEETING.

THE annual meeting of the Boston Society of Civil Engineers will be held at the Boston City Club, corner of Somerset Street and Ashburton Place, Boston, on Wednesday, March 17, 1915.

As previously announced, the annual meeting this year will consist of three principal features: a business meeting at noon, the annual dinner in the afternoon, and the smoker in the evening.

Business Meeting. — The annual meeting required by the Constitution will be called to order at 12 o'clock M. in the Assembly Room on the third floor of the new Club House.

Business. — Announcement of the election of new members.

To receive the annual reports of the Board of Government, of the Treasurer and of the Secretary.

To receive the annual reports of the several special committees.

To reappoint the several special committees.

Announcement of the result of letter-ballot for officers for the ensuing year.

Presentation of the Desmond FitzGerald Medal.

Address of the retiring President.

Annual Dinner. — The thirty-third annual dinner will be served at half past one o'clock P.M., in the main banquet hall or auditorium on the fourth floor of the new Club House.

At three o'clock Mr. Frederic H. Newell, consulting engineer of the United States Reclamation Service, will give an

illustrated lecture on water storage, particularly as applied to irrigation and water power in the West.

Smoker. — The usual informal smoker will be held in the evening, beginning at seven o'clock, in the main banquet hall.

S. E. TINKHAM, *Secretary.*

PAPERS IN THIS NUMBER.

"Insurance for Engineers." Nathan H. Daniels.
(Presented January 27, 1915.)
Discussion of "The Hydro-Electric Power Plant at the Wachusett Dam."
Discussion of "The Commission-Manager Form of Government."
Memoirs of Deceased Members.

CURRENT DISCUSSIONS.

Paper.	Author.	Published.	Discussion Closes.
"Commission-Manager Government."	H. M. Waite.	Jan.	March 15.
"Economic Depth of Trickling Filters."	H. P. Eddy.	Feb.	April 15.
"Depth of Filtering Material."	H. W. Clark.	Feb.	April 15.

MINUTES OF MEETINGS.

BOSTON, February 17, 1915. — A regular meeting of the Boston Society of Civil Engineers was held this evening at Chipman Hall, Tremont Temple, and was called to order at 8 o'clock by the President, Harrison P. Eddy. There were present 105 members and guests.

By vote the reading of the records of the meetings held January 13 and January 27, 1915, was dispensed with, and they were approved as printed in the February JOURNAL.

The Secretary reported for the Board of Government that it had elected the following to membership in the grades named:

Members — Arthur Benson Appleton, William Joseph Buckley, Fayette Samuel Curtis, Everett Frank Dowst, Gilbert Munday Harris, Carl Perry Hubbard, Arthur Caswell King, John Robert Nichols, Frederick Dexter Smith and Merton Rogers Sumner.

Associate — Wallace Brainard Conant.

Juniors — Martin Warren Cowles and Charles Loring Hall.

Mr. William S. Johnson then read the paper of the evening entitled, "Ground Water Supplies." The paper was fully illustrated by lantern slides.

In the discussion which followed the reading of the paper, the following took part: Robert Spurr Weston, Allen Hazen, Henry A. Symonds.

S. E. Tinkham, *Secretary.*

Sanitary Section.

Boston, Mass., February 3, 1915.—A meeting of the Sanitary Section of the Boston Society of Civil Engineers was held this evening in the library of the Society, Tremont Temple. The meeting assembled at 8 o'clock with the Chairman presiding.

The Chairman appointed the following special committee to study and report upon "Methods of Design and Construction and Results of Operation of Inverted Siphons for Carrying Sewage Only and for Storm Water": Wm. S. Johnson, Chairman; R. M. Whittet, Dwight Porter.

The Chairman also appointed the following committee to nominate officers of the Section for the coming year: Frank A. Barbour, Chairman; Frank B. Sanborn, Edward Wright, Jr.

The first speaker of the evening was Dr. Frederic Bonnet, Jr., professor of chemistry, Worcester Polytechnic Institute, who spoke on the subject, "Garbage Disposal at Worcester, Mass." Dr. Bonnet described in a most interesting manner the methods used in feeding garbage to hogs, and the steps necessary

to prevent odors and to preserve sanitary conditions on the farm. He also spoke of the methods used to prevent disease among the pigs. An excellent collection of lantern slides was used in illustration.

Mr. W. J. Springborn, manager of the New Bedford Extractor Company, gave a talk on "Garbage Reduction Plants," describing in particular the plants at Cleveland, Schenectady and New Bedford. The opaque projector was used to throw photographs on the screen and added considerably to the interest of the talk.

Mr. E. G. Whittemore, superintendent of the Springfield Merg Reduction Company, and a number of other gentlemen, took part in the discussion.

There were thirty present. On account of the severe storm, only a few of the out-of-town members were present. Meeting adjourned at 10.40 o'clock.

FRANK A. MARSTON, *Clerk.*

BOSTON, MASS., March 3, 1915. — The annual meeting of the Sanitary Section, Boston Society of Civil Engineers, was held this evening in the Society library, Tremont Temple.

Dinner was served at the Boston City Club at 6 o'clock, in one of the private dining rooms on the ninth floor. There were 36 present, and, as usual, the occasion was a very enjoyable one.

At the close of the dinner the Chairman surprised the Clerk in a most delightful way by presenting him, on behalf of the Section, with a gold watch charm and fob, as a token of appreciation of his services during the past four years. A large bouquet of roses was sent to Mrs. Marston with the compliments of the Section.

The Chairman then read a short paper dealing with the work of the Section, and the outlook for the future. Short addresses were also made by Harrison P. Eddy, President of the Society, and George C. Whipple, Past-Chairman of the Section.

The business meeting was called to order by Chairman Bertram Brewer at 8.15 o'clock, in the Society library.

As there were no objections, the reading of the minutes of the February meeting were postponed and ordered printed in the JOURNAL.

The report of the Executive Committee for the past year was read by the Clerk. Voted to accept the report and place it on file.

The report of the nominating committee was presented by F. B. Sanborn. Voted to accept the report.

Voted that the polls be closed and that the Clerk be instructed to cast a ballot for the officers and members of the Executive Committee as nominated. The following were declared elected to serve for the ensuing year:

Chairman—Stephen DeM. Gage.

Vice-Chairman—Dr. Frederic Bonnet, Jr.

Clerk—Frank A. Marston.

Additional members of Executive Committee: Bertram Brewer, Hiram A. Miller, Austin L. Maddox.

The Chairman then presented Mr. David A. Hartwell, chief engineer of the Sewage Disposal Commission, Fitchburg, Mass., who read a very interesting paper on "The Sewage Disposal Works at Fitchburg, Mass." At the close of the paper, the speaker showed some seventy lantern slides, illustrating the various stages of the construction work and the details of the several structures.

The retiring Chairman then introduced the new Chairman of the Section, Mr. Stephen DeM. Gage, who spoke briefly in regard to the work of the Section.

The meeting adjourned at 9.45 o'clock. There were 61 present at the meeting.

FRANK A. MARSTON, *Clerk.*

APPLICATIONS FOR MEMBERSHIP.

[March 8, 1915.]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

ALLEN, JOHN EDWARDS, Worcester, Mass. (Age 22, b. Holyoke, Mass.) Senior at Worcester Polytechnic Inst., civil engineering course. Refers to C. M. Allen, Frederic Bonnet, Jr., A. W. French, H. C. Ives and A. J. Knight.

BRACKETT, LEROY GILE, Somerville, Mass. (Age 23, b. Biddeford, Me.) Graduate of Boston Y. M. C. A. Evening Polytechnic School, 1913, civil engineering course. From winter of 1911 to June, 1914, with Silverman Engineering Co. as rodman, transitman and draftsman; since that time has been with the N. Y., N. H. & H. R. R., first in the Construction Dept. and later in office of Division Engineer, under J. W. Pearson; has worked chiefly as draftsman. Refers to H. W. Bacon, C. B. Humphrey, C. H. Restall, W. J. Semple and A. S. Tuttle.

COBURN, RAYMOND WILLARD, Weston, Mass. (Age 28, b. Weston, Mass.) Graduate of Harvard College, 1910, degree of A.B.; spent last half-year in Graduate School of Applied Science; entire course followed civil engineering lines. From Aug., 1910, to Jan., 1911, resident engineer with Mass. Highway Comm.; from Jan. to Sept., 1911, with Middlesex County as transitman and assistant engineer; from Sept., 1911, to Jan., 1912, with Mass. Highway Comm.; from April to Oct., 1912, engineer for Town of Nahant on highway work; from Oct., 1912, to Jan., 1914, resident engineer for Mass. Highway Comm. in Dracut and Methuen; from Jan., 1914, to date, resident engineer for Mass. Highway Comm. in Swampscott. Refers to G. W. Cutting, Jr., A. W. Dean, H. J. Hughes, F. H. Kendall, J. J. Preble and A. E. Tarbell.

FOLEY, ERNEST LEON, West Newton, Mass. (Age 21, b. Waltham, Mass.) Graduate of Newton Technical High School; student in extension courses, University of Wisconsin, and in evening buildings course at Mass. Inst. of Technology. Practical experience covers period of nearly four years and includes work as draftsman and erection superintendent on various kinds of machinery. Refers to H. W. Haywood, H. B. Johnson and W. H. Lawrence.

GAMMAGE, ARTHUR L., Everett, Mass. (Age 30, b. Woonsocket, R. I.)

Graduate of Worcester Polytechnic Inst., 1907. From Oct., 1907, to March, 1911, assistant chemist for Connecticut State Board of Health; from March, 1911, to date, chemist for Robert Spurr Weston, consulting engineer, Boston, Mass. Refers to F. P. Bonnet, Jr., H. P. Eddy, F. A. Marston, G. A. Sampson, E. C. Sherman and R. S. Weston.

GAUDREAU, LUCIEN ERNEST DAMIEN, South Braintree, Mass. (Age 27, b. New Bedford, Mass.) Received technical education from I. C. S., course in mining engineering, 1908, and course in theory and design of steel and concrete at Franklin Union, 1912. From Sept., 1909, to Oct., 1910, chainman and rodman on irrigation projects with Arnold Engineering Co. of Chicago, at Denver, Colo.; from Oct., 1910, to date, with N. Y., N. H. & H. R. R. Co., Boston, first as rodman in Maintenance of Way Dept., later as inspector and finally as transitman. Refers to Isaac Rich, H. L. Ripley, G. T. Sampson, A. S. Tuttle and H. L. White.

GREENE, FRANCIS INGRAHAM, Newport, R. I. (Age 32, b. Newport, R. I.) Graduate of Brown University, degree of B.S. in civil engineering, 1906. From July, 1906, to Dec., 1911, with O. Perry Sarle, civil engineer, Providence, R. I.; from Dec., 1911, to date, with U. S. Engineer Department; is now Junior Engineer with that department. Refers to A. S. Ackerman, A. H. Blanchard, H. B. Drowne and A. J. Ober.

MILLER, JAMES MARK REAVELY, Roxbury, Mass. (Age 37, b. Galashields, County of Selkirk, Scotland.) Graduate of Edinburgh Normal School, 1892; student for five years in engineering classes of Boston Y. M. C. A. evening school, American School of Correspondence, etc. During year 1901 with sugar mill company in Porto Rico on erection of machinery and buildings; from 1902 to 1904 with General Electric Co., Lynn and Schenectady, on detail and design of special machinery and buildings; 1905, with Kindl & Glaffey, consulting engineers, on general office work, inspection and reports; 1906, with Westinghouse, Church, Kerr & Co., on structural steel design and details; also with W. S. Barstow Co., New York, N. Y.; 1908 with city engineer of San Francisco on inspection of reinforced concrete cisterns; 1907, with Associated Oil Co. of California on remodeling of plant; from 1909 to 1910, with D. H. Burnham Co., Chicago, on structural steel design and detail; from 1912 to 1913, with Interstate Commerce Commission; 1914, with city architect of Cleveland, O., on designing and supervision of all his engineering work; 1915, designing structural steel for architects and industrial corporations. Refers to C. M. Spofford.

NEWSOM, REEVES JOSE, Swampscott, Mass. (Age 21, b. Columbus, Ind.) Graduate of Purdue University, 1913; one year's graduate work at Mass. Inst. of Technology, 1913–14. Since June, 1914, has been in the office of city engineer, Lynn, Mass., on water supply work. Refers to H. K. Barrows, C. B. Breed, R. H. Sutherland and W. L. Vennard.

SARLE, OLIVER PERRY, Providence, R. I. (Age 52, b. Warwick, R. I.) Began practice of engineering with J. Herbert Shedd, 1886; since that date has been employed chiefly on hydraulic and sanitary work; has had experience on about forty dams and over fifty water-works plants; recently built

sewage disposal works for Central Falls, R. I., and is now designing for Warwick, R. I., water-works plant which will involve expenditure of more than a half-million dollars. Refers to W. D. Bulloc, G. A. Carpenter, O. F. Clapp, J. W. Ellis, A. T. Safford and F. E. Waterman.

TAYLOR, PHILIP W., Fitchburg, Mass. (Age 26, b. Arlington, Mass.) Graduate of Mass. Inst. of Technology, 1910, civil engineering course. From June to Oct., 1910, transitman with C. C. C. & St. L. R. R.; from Oct., 1910, to June, 1911, transitman with B. & M. R. R.; from June, 1911, to Sept., 1912, transitman with Sewage Disposal Commission, Fitchburg, Mass.; from Sept., 1912, to date, assistant engineer with Sewage Disposal Commission, Fitchburg, in charge of designs and office work. Refers to H. P. Eddy, D. A. Hartwell, F. A. Marston, Dwight Porter, J. P. Snow and C. M. Spofford.

LIST OF MEMBERS.

ADDITIONS.

ALDEN, FREDERICK T. ..... 109 Porter St., Malden, Mass.
BAKER, LLOYD E. ..... 51 Congress Ave., Providence, R. I.
BROWN, WALTER K. ..... 227 Rawson Road, Brookline Mass.
CARR, JOSEPH L. ..... 91 Bellingham St., Chelsea, Mass.
CONANT, WALLACE B. ..... Concord, Mass.
CURTIS, FAYETTE S. ..... 7 Revere St., Jamaica Plain, Mass.
DALTON, MARSHALL B. ..... 12 Newbury St., Boston, Mass.
DAVIS, HAROLD F. ..... 441 Main St., Reading, Mass.
DEMERRITT, ROBERT E. ..... 119 Haven St., Reading, Mass.
DINGMAN, CHARLES F. ..... Palmer, Mass.
DOWST, EVERETT F. ..... Concord, N. H.
DURGIN, CLYDE M. ..... 21 Ashfield St., Roslindale, Mass.
EBERHARD, WALTER C. ..... 138 Poplar St., Roslindale, Mass.
EDDY, HARRISON P., JR. ..... 65 Gray Cliff Road, Newton Centre, Mass.
EDGAR, CHARLES L. ..... 70 State St., Boston, Mass.
FARWELL, ROBERT B. ..... 15 Beacon St., Boston, Mass.
FLETT, LOUIS E. ..... 154 Youle St., Melrose, Mass.
GALLENE, VICTOR J. ..... Y. M. C. A., Fall River, Mass.
GLADDING, RAYMOND D. ..... 1049 Beacon St., Brookline, Mass.
HAKES, JESSE F. ..... 37 W. Preston St., Baltimore, Md.
HANNA, JOHN B. ..... 273 Middle St., Pawtucket, R. I.
HUBBARD, CARL P. ..... 26 Vernon St., Woburn, Mass.
IVES, HOWARD C. ..... Worcester Polytechnic Inst., Worcester, Mass.
KNIGHT, ARTHUR J. ..... Worcester Polytechnic Inst., Worcester, Mass.
KNOWLTON, ARTHUR W. ..... St. Johnsbury, Vt.
NICHOLS, JOHN R. ..... 82 Avon Hill St., Cambridge, Mass.
O'BRIEN, JAMES A. ..... 100 Bloomingdale St., Chelsea, Mass.

PATTON, EUGENE S.....166 Mulberry St., Pawtucket, R. I.
PINKHAM, MILLARD B.....172 Walnut Ave., Roxbury, Mass.
PREBLE, FRANK L.....14 Beacon St., Boston, Mass.
SMITH, FREDERICK D.....25 Waverley St., Malden, Mass.
THAYER, BURDETT C.....Clinton, Mass.
THOMAS, HOWARD C.....200 Washington St., Wellesley Hills, Mass.
TOSI, JOSEPH A.....15 Harvard St., Worcester, Mass.
WALES, WITHROP L.....11 Danville St., West Roxbury, Mass.
WORCESTER, ROBERT J. H.....5 Stow St., Concord, Mass.

CHANGES OF ADDRESS.

BEACH, THEODORE M.....111 Bowles St., Springfield, Mass.
BESSEY, ROY F.....273 Martense St., Brooklyn, N. Y.
BRYER, CHARLES S.....313 Hunnewell St., Needham Heights, Mass.
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CARTER, HAROLD L.....281 Tappan St., Brookline, Mass.
CHAMBERLIN, GEORGE E.....15th St. and Western Ave., Chicago, Ill.
COFFIN, S. P.....135 Harvard St., Medford, Mass.
DALTON, THOMAS V.....16 Ridgemont St., Allston, Mass.
DASHPER, FREDERICK C.....835 Hyde St., San Francisco, Cal.
ELLIS, LESTER F.....493 Commercial St., Portland, Me.
FOGG, BENJAMIN G.....Maine St., West Newbury, Mass.
FOSTER, WILLARD M.....Shrewsbury, Mass.
GARTLAND, EDWARD V.....71 Topliff St., Dorchester, Mass.
GERRISH, HERBERT T.....172 Condor St., East Boston, Mass.
HALE, ROBERT S.....939 Boylston St., Boston, Mass.
HATHAWAY, ERWIN O.....Nashua, N. H.
HOSMER, GEORGE L.....Mass. Inst. of Technology, Boston, Mass.
KIDD, ALEXANDER L.....501 City Hall Annex, Boston, Mass.
LEE, EDWARD G.....11 Lisbon St., Lewiston, Me.
LINK, JOHN W.....208 S. La Salle St., Suite 1900, Chicago, Ill.
LOCHRIDGE, ELBERT E.....Box 1238, Springfield, Mass.
MACKSEY, HENRY V.....Supt. of Public Works, Woburn, Mass.
MILLER, WILLIAM L.....171 Alford St., Boston, Mass.
MORSE, CHARLES F.....215 Clinton St., Watertown, N. Y.
ROBINSON, HAROLD L.....27 Winthrop St., Winchester, Mass.
SARGENT, ALBERT F.....423 Main St., Malden, Mass.
SAVILLE, THORNDIKE.....Wilder Laboratory, Hanover, N. H.
STARR, JOHN A.....31 Brighton Ave., Allston, Mass.
STORRS, HARRY A.....720 South 6th Ave., Tucson, Ariz.
TANNATT, WILLARD C., JR.....Town Hall, Easthampton, Mass.
WHIPPLE, GEORGE C.....6 Berkeley Place, Cambridge, Mass.
WILEY, WALTER T.....703 City Hall Annex, Boston, Mass.

EMPLOYMENT BUREAU.

THE Board of Government maintains an employment bureau for the Society, to be a medium for securing positions for its members and applicants for membership, and also for furnishing employees to members and others desiring men capable of filling responsible positions.

At the Society room two lists are kept on file, one of *positions available* and the other of *men available*, giving in each case detailed information in relation thereto.

MEN AVAILABLE.

290. Age 31. Student for two years at Mass. Inst. of Technology. Has had eight years' experience in drawing, including five years on mechanical and three on civil engineering work; has had experience on location and valuation field work for railroads and on structural steel and concrete work. Salary desired, $20 per week.

291. Age 24. Received technical education at Mass. Inst. of Technology, civil engineering course, class of 1913. Has had one year's experience in drafting and inspecting for cotton mill. Salary desired, $3 per day.

292. Age 27. Graduate of Mass. Inst. of Technology, 1909, degree of S.B. in civil engineering. Has had one year's experience in surveying with Comm. of Mass.; two years as assistant in civil engineering at Mass. Inst. of Technology; six months as assistant superintendent with Aberthaw Construction Co.; one year as hydraulic engineer, U. S. F. S., on stream gaging; six months as structural steel draftsman; two years as designing engineer on reinforced concrete; six months as superintendent on construction of water and sewerage plant. Desires designing or executive engineering work, preferably in office; salary to be commensurate with work.

293. Age 40. Special student at Mass. Inst. of Technology for three years. Has had over twelve years' experience with various engineering firms and architects in Boston and vicinity; experience includes all classes of construction drafting and writing of construction specifications; has had charge of men. Salary desired, $25 per week.

294. Age 27. Graduate of Tufts College, 1914, with degree of B.S. in civil engineering. Has had one summer's experience as rodman for city engineer and four months' experience as draftsman and detailer on reinforced concrete work with Stone & Webster Engrg. Corp. Desires field or office work in civil or structural engineering. Salary desired, $60 per month.

295. Age 26. Graduate of Mass. Inst. of Technology. Has had three months' experience as transitman for city engineer, Beverly; three months as inspector on sewer construction for city engineer, Malden; two and a half months on water system installation at Duxbury; two months on New York

State Barge Canal as junior assistant engineer. Desires position as transitman, inspector or assistant engineer. Salary desired, $18 per week.

296. Age 34. Received technical education at Mechanic Arts High School, Boston, and from one year's study in technical courses at Franklin Union. Has had one year's experience as rodman for Met. Park Comm.; three years as transitman on surveys and construction of electric roads; one year as instrumentman with Charles River Basin Comm.; three and one-half years as topographic draftsman, Bureau of Engineering, Borough of Richmond, New York City; three years on municipal and private work for Geo. A. Smith, town engineer, Norwood, Mass.; one year with Stone & Webster as draftsman and inspector on new Technology buildings. Desires position with contractor or town engineer.

LIBRARY NOTES.

Recent Additions to the Library.

U. S. Government Reports.

Annual Report of Director of Geological Survey for 1913–14.

Deep Well at Charleston, South Carolina. Lloyd William Stephenson.

Geology and Oil Prospects of Northwestern Oregon. Chester W. Washburne.

Geology of Hanagita-Bremner Region, Alaska. Fred H. Moffit.

Glacier National Park. Marius R. Campbell.

Gold, Silver, Copper, Lead and Zinc in Arizona in 1913. V. C. Heikes.

Gold, Silver, Copper, Lead and Zinc in Colorado in 1913. Charles W. Henderson.

Gold, Silver, Copper, Lead and Zinc in Montana in 1913. V. C. Heikes.

Publications by Survey Authors on Metals and Non-Metals except Fuels. Isabel P. Evans, Ed.

Rochester Mining District, Nevada. Frank C. Schrader.

Rutile Deposits of Eastern United States. Thomas L. Watson.

Results of Spirit Leveling in Nebraska, 1896 to 1913 inclusive. R. B. Marshall.

Results of Spirit Leveling in Wisconsin, 1897 to 1913 inclusive. R. B. Marshall.

Water-Supply Papers 331 and 335.

State Reports.

Louisiana. Cotton Warehouses and Terminal at New Orleans. Ford, Bacon & Davis.

Massachusetts. Annual Report of State Board of Health for 1913.

County Reports.

Essex County, Mass. Engineer's Report for 1914.

Municipal Reports.

Boston, Mass. Building Law.

London, England. Abstract of Accounts, Metropolitan Water Board, for 1913–14.

Minneapolis, Minn. Annual Reports of Registrar of Water Works for 1903, 1910 and 1913.

North Adams, Mass. Annual Report of Department of Public Works for 1914.

Miscellaneous.

Aborigines of South America. G. E. Church. Gift of Clemens Herschel.

Engineering Index for 1914.

Institution of Civil Engineers (London). Minutes of Proceedings, Vol. CXCVII.

Industrial Arts Index for 1914.

Leonardo da Vinci. Richard Muther.

Leonardo da Vinci's Note-books. Edward McCurdy, Tr.

Leonard de Vinci. Gabriel Seailles.

Leonardo der Techniker und Erfinder. Franz M. Feldhaus.

(The) Miracle Man. Frank L. Packard.

Above five items gift of Clemens Herschel.

New International Encyclopædia, Vols. VII and VIII.

Vitruvius: The Ten Books on Architecture. Morris Hickey Morgan, Tr. Gift of Clemens Herschel.

LIBRARY COMMITTEE.

NEW ENGINEERING WORK.

(Under this head a brief description of new engineering work contemplated or under construction will be presented each month. Engineers and contractors are requested to send descriptions of their work to the Secretary, 715 Tremont Temple, Boston, before 1st of each month.)

Commonwealth of Massachusetts. — DIRECTORS OF THE PORT OF BOSTON. — Hydraulic dredge *Tampa* at work in reserved channel placing dredged material inside bulkheads of proposed piers near dry-dock site.

Boston Transit Commission. — *Dorchester Tunnel.* — The work on Sections D and E was described in the February issue of the JOURNAL.

Work will soon commence on the construction of Section H, located in Dorchester Ave. between Old Colony Ave. and Woodward St., and about 2 200 ft. long. The structure is to be mainly of reinforced concrete, and consists of a double-track tunnel to be built by the cut-and-cover method. The work also includes a pump well, an emergency exit and sewer changes.

City of Boston. — PUBLIC WORKS DEPARTMENT, HIGHWAY DIVISION, PAVING SERVICE. — Work is in progress on the following streets:

Deering Road,	Blue Hill Ave. to Harvard St.	Bituminous macadam.
Spring St.,	Gardner St. to Webster St.	Bituminous macadam.
Seaver St.,	Humboldt Ave. to Walnut Ave.	Excavating and grading.
Seaver St.,	Humboldt Ave. to Blue Hill Ave.	Excavating and grading.
Temple St.,	Spring St. to Ivory St.	Excavating and grading.
East First St.,	Across water passageway.	Building sea wall.

PUBLIC WORKS DEPARTMENT, SEWER AND WATER DIVISION, SEWER SERVICE. — The following work is in progress:

Beach St., between Atlantic Ave. and Harrison Ave., replacing wooden sewer with one of reinforced concrete.

Union Park St., sewage pumping station; installing motors.

Milton St. (Hyde Park), sewage ejector pumping station; completed but not in commission.

Dorchester Brook sewer, rebuilding between Brook Ave.

Place and Brookford St., Dorchester, large concrete surface drain and 12 in. and 15 in. pipe sanitary sewers in same trench.

Davenport Brook concrete conduit, Adams and Minot Sts., Dorchester.

Dent Street Brook conduit, West Roxbury, in private land; Pleasant and Lagrange Sts., circular concrete conduit.

Faneuil Valley Brook conduit in Faneuil and Oakland Sts., between Newcastle Road and Bennett St., Brighton; large circular concrete conduit and 12-in. pipe sanitary sewer.

The Fore River Shipbuilding Co., Quincy, Mass., has the following work in progress:

U. S. Battleship *Nevada.*

Nineteen U. S. submarine boats.

U. S. Torpedo Boat Destroyers *Cushing, Tucker, No. 63* and *No. 64.*

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PAPERS AND DISCUSSIONS

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INSURANCE AS AN AID TO ENGINEERS.

By Nathan H. Daniels, M.Am.I.E.E.

(Presented January 27, 1915.)

It is always a pleasure for an engineer to share his experience with his fellows, particularly if his work has been somewhat out of the ordinary. For a number of years I have had to do with the insurance of a large number of electric companies, under such circumstances that it has been necessary to study insurance problems from all points of view. While the work has taken in all branches, I shall speak only of fire insurance tonight, as this is the largest and most representative class; but the same general ideas will apply to the other classes.

It has frequently been necessary for me to examine plans for new construction or for alteration of existing buildings to see if the fire hazards have been reduced to a minimum. One would naturally expect the engineer who designs a building to be quite familiar with all elements which endanger it, and of these fire is one of the greatest, but I have not found this to be the case. It is not the engineer who designs the property, but the insurance companies who pay the losses on it, who have studied the subject and have developed standards of construction.

Note. Discussion of this paper is invited, to be received by Edward C. Sherman, Editor, 6 Beacon Street, Boston, before May 15, 1915, for publication in a subsequent number of the Journal.

The information which the insurance companies have accumulated on this subject has been of the greatest assistance to me in my work, and it is a real pleasure to come here to-night and tell you of some ways in which I have found insurance an aid to engineers.

Nearly every property is liable to damage by fire. The disaster may come at any time, and may be so large as to seriously disturb the finances of the company. By carrying insurance, an annual payment is substituted for this menace, a certainty is substituted for an uncertainty, and this condition conduces to greater business stability. Were it not for insurance, many large engineering enterprises would be financial impossibilities. They usually require large amounts of borrowed capital, and this cannot be obtained on attractive terms unless satisfactory security is offered, hence the mortgage covering the property usually requires that a reasonable amount of insurance shall be carried. Insurance is even more important for the protection of stockholders, as they own only the equity above the mortgage, and must suffer a total loss before the borrowed capital suffers as a result of any misfortune.

Insurance is based on the law of averages, and, as few business concerns own a sufficient number of risks of similar nature to create an average record, a pooling of the risks of many owners becomes necessary. One of the functions of an insurance company is to combine the experience of a large number of risks and to distribute the fire loss equitably among its policy holders.

Fire insurance rates are determined primarily from the loss records, just as life rates are determined from the mortality tables. If all fire risks were of a single type, such as dwelling-houses, the rates could be reduced to as simple formulæ as life rates; but with modern business there are countless classifications, each with its distinct hazards. Even within a single group, such as electric-power stations, the possibility of fire in the individual risks will vary between wide limits, depending on the construction and conditions of operation.

To determine correctly the insurance rate on any given plant, it is necessary that we know the general record of that class of risk, and also that we assign values to any special hazards

that may be present in the particular property. Work along these lines by the insurance companies' engineers has resulted in a scientific development of rating schedules for different classes of risks. These generally start with a certain base rate which represents the cost of insurance on a standard property of the class in question in which the hazards are minimized, and to this base rate charges are added for any deficiencies in or departures from the requirements set forth for the standard property.

These rating schedules are of great benefit to a person designing a new building or contemplating changes in an old one, for they indicate the most desirable types of construction from the standpoint of fire danger, while the amount of hazard which will be added if various deficiencies are allowed to creep in is shown by the added charges.

Under the schedule for rating electric-power stations which is very generally used outside of New England, a fireproof station absolutely standard in construction and occupancy takes a rate of 7c. per $100 of insurance for building and non-electrical contents, and 12c. for electrical contents. If the building has unprotected metal columns supporting roof or floors, 1c. is added to the above base figures; if wood skylights, 2c. for the first and 1c. for each additional, with a maximum charge of 7c.; if joisted wood floors, 10c.; if combustible finish leaving concealed space in walls, 3c.; if oil transformers, unless in fireproof rooms, 3c.; if lightning arresters are not standard, 2c.; if wood lockers, 2c.; if gasoline is stored in building, 15c.; if nearest fire hydrant is over 500 ft. distant, 5c.; if near another building, an exposure charge depending on the intervening distance, the construction of the building walls and the protection to openings in same. These are merely examples of a few of the charges but will suffice to indicate their scope and that insurance rates are determined by actual conditions of construction and occupancy found in each individual property.

To illustrate the range of insurance rates on electric-power station buildings, a standard building takes the base rate of 7c. above mentioned, while a frame shingle-roofed building with unprotected openings to basement, defective switchboard and wiring, careless housekeeping and no fire protection would take

a rate of $2.50 to $3.00 — or about forty times the rate on the standard station.

On first thought it would seem that the insurance companies would be anxious to write policies on the latter risk on account of the high rate, but the reverse is true and many companies would refuse to accept any insurance whatsoever on the high rated risk.

Each additional 10c. in the insurance rate of a one-hundred-thousand-dollar power station means $100 annually in insurance premium, or 5 per cent. interest on an investment of $2 000. Of even more importance is the increase in danger from fire and the possible interruption of service which it may cause. This can be considered roughly as proportional to the fire insurance rate, or forty times as great in the poorer station above mentioned as in the standard station.

Such analysis of risks is of much assistance in guiding future construction, but the insurance companies have gone further and devoted a great deal of study to methods of reducing fire dangers by better types of construction and safer appliances, which information is gladly furnished without charge to all persons interested.

Much of this work is done by the National Board of Fire Underwriters, an organization which is supported by the insurance companies, with its headquarters at 123 William Street, New York City. The National Board works along many lines, but that portion of its work which particularly interests us tonight is the study which it makes of many common fire dangers and of means for controlling or extinguishing fires, with a view to developing methods of construction or types of apparatus which will minimize the possible damage.

These investigations of the National Board are often made at the suggestion of other organizations interested in the subject, notably the National Fire Protection Association, of which I shall say more later. In this work the National Board endeavors to consider all elements of design, cost and use which enter into the problem, and consults freely with representatives of organizations interested in the particular subject under consideration.

It also maintains at Chicago a subsidiary organization, the

Underwriters' Laboratories, Incorporated, which, as its name indicates, maintains extensive laboratories equipped to make all tests necessary in connection with the work of the National Board, this including tests on raw materials and methods of manufacture, as well as on the finished product.

The results of the investigations are published by the National Board and are known as the National Board Rules for Standard Construction, which are a recognized authority in the matters to which they relate. One set of these Rules, with which many of you are probably familiar, is the National Electric Code for electric wiring and installation of electrical apparatus. This prescribes standard requirements for electric wiring and apparatus, and standard methods for its installation, and is prepared by the National Board and the National Fire Protection Association in consultation with representatives of the National Electric Light Association and manufacturers of electrical supplies. The National Board has made careful studies in many other lines, and has published pamphlets covering the construction and installation of fire doors, hose houses, gas and gasoline engines, moving-picture machines, acetylene-gas machines, coal-gas producers, automatic-sprinkler installations, etc. As an example of the wide scope of its investigations, I may mention that it has even produced a pamphlet on the construction and installation of incubators and brooders.

The National Board Rules often specify in considerable detail the materials to be used and the methods of manufacture for producing standard apparatus. It is often difficult, if not impossible, for an inexperienced person to determine whether a particular article complies with the standard requirements, and it is often difficult for an expert to determine the question without destroying the article. This is clearly shown in the case of a fire door. To meet the National Board standard, a fire door must be built of three layers of clear non-resinous wood, put together in a certain way and fastened with wrought-iron nails carefully clinched. This body is then covered with tin of a given weight, the joints being locked in a prescribed manner. It is evidently impossible for any one to examine a finished door and determine whether it is standard, for even if the tin covering appears to

be of the proper weight and properly applied, one cannot determine, without destroying the door, whether the core is of white pine or similar wood properly put together. In the absence of proof of standard manufacture, an insurance company might be unwilling to give full credit for such a door located at an important point.

To meet this difficulty, the Underwriters' Laboratories developed what is known as their labeled service about ten years ago. By this arrangement any manufacturer who is desirous of having any of his product known as fully meeting the requirements of the National Board Rules can arrange to have representatives of the Underwriters' Laboratories visit his property and follow the materials and the process of manufacture, and if it is found that the requirements have been fully met and the product is in every way standard, a label is attached to the finished article stating that it has been inspected and approved by the Underwriters' Laboratories. You will find this label on a great variety of apparatus, including fire doors, fire extinguishers, fusible links, fire retarding paint, etc. Its presence on any article is a guaranty that the product has been inspected during manufacture and that it fully meets the requirements of the National Board Rules. It fully answers any question as to the ability of the article to perform the service expected of it.

I am sorry to say that some engineers do not appreciate the advantages of using labeled apparatus. The cost of labeled service is only a small fraction of the selling price of the finished article, hence it often happens that the lower price at which an unlabeled article can be purchased is obtained at the sacrifice of quality. At one time I was inclined to question the advisability of using labeled apparatus myself, but in the light of longer experience I believe that it should be used whenever possible, since it is the best guaranty one can have of standard quality.

Any reference to the work which the insurance companies have done toward improving standards and disseminating information regarding the best forms of construction will be incomplete if I do not refer to the Factory Mutual Companies, as they are commonly called, who were really the pioneers in this work. These companies were started over fifty years ago, at a

time when the stock insurance companies did not give the same careful study to the estimation of fire hazards and the development of rates which they do to-day. Many mill owners felt that they were being charged excessive rates for insurance on their property, so a number of them formed an association for the purpose of carrying their own insurance. To reduce the cost, they began a careful study of fires in their own and other properties, to ascertain the most frequent causes of fire, and then studied the means of eliminating or reducing these causes. Almost from inception, they adopted a policy of declining to insure any risk which did not come up to their standard. They developed improved types of construction, and refused to take new members into their association, or to continue old ones, unless their properties conformed to these standards. As new standards of fire protection were developed, these too were required. This policy has been consistently maintained up to the present time, so that the term "a Mutual risk" means that the property is of the best type of construction and well protected against fire. The Mutuals have confined their activities almost entirely to factories, storehouses and electric-power stations. Where the building is of combustible construction or contains any considerable amount of combustible material, they usually require complete protection by automatic sprinklers.

The method which the Mutuals follow in determining the cost of insurance also differs from that of the stock companies. It is the policy of the Mutuals to make a high initial charge for insurance, and to return, at the end of the policy period, such portion of the premium as has not been used in paying losses, administration charges, etc., in the form of a dividend. A plant may pay an initial rate of 1 per cent., that is, $1 for each $100 of insurance, and at the end of the year get back 85c., making the net cost 15c., to which we will perhaps be justified in adding interest on the 85c. which the insurance company has been allowed to use for the year, which at 5 per cent. will amount to $4\frac{1}{2}$c., making the total cost of insurance $19\frac{1}{2}$c. for the year. It is evident that the cost of Mutual insurance will vary, depending on the amount of losses which the companies sustain in any given year. The stock companies, on the other hand, have adopted

the policy of making but one charge for the insurance, which is paid at the beginning of the policy period. The stock companies make a profit or loss on their underwriting according as their losses are greater or less than was anticipated.

The stock insurance companies have formed still other organizations, for the purpose of handling what we may call the commercial side of their business; that is, the making of rates, prescribing forms of policies and writing insurance. The body having such matters in charge for this city is the Boston Board of Fire Underwriters, at 55 Kilby Street, while for the rest of New England matters are handled by the New England Insurance Exchange, at 141 Milk Street. Attached to each of these bodies are engineers who are familiar with the work and studies which have been made along the lines of fire prevention, and who will gladly furnish advice regarding these matters and copies of the National Board Rules, etc., to any engineer or property owner who applies directly or through his insurance representative. The Mutual Companies are equally ready to assist in matters relating to risks such as they handle, and their representatives can be found at 31 Milk Street, Boston. I have always found these organizations glad to render all possible assistance in matters within their province.

Another organization which is a great help to those who wish to keep in touch with the subject is the National Fire Protection Association, whose headquarters are at 87 Milk Street in this city. The Association was formed in 1896 to promote insurance and improve the methods of fire protection and prevention. The majority of the underwriters' associations of this country, as well as many engineering and other societies, are among its active members. Any individual who is interested can become a member by paying a nominal annual fee. The Association holds frequent meetings, it publishes a magazine four times a year containing a great deal of information regarding work along lines of fire prevention, as well as giving details of many interesting fires which have occurred. Should there be a large fire of general interest, a special pamphlet describing it is sent to the members. The Association coöperates very closely with the National Board of Fire Underwriters in the preparation and revision of the

National Board Rules, much of the work being done by committees of the Association, whose reports are later adopted by the National Board. The National Fire Protection Association keeps its members in touch with progress along the lines of fire protection and prevention, exactly as your own Society keeps you in touch with the progress in your chosen line of engineering. I know of no better way of keeping in touch with the subject of fire prevention than by membership in the N. F. P. A.

I believe that engineers who are confronted with problems involving the element of fire hazard can get real help by consulting freely with the insurance engineers in regard to that phase of the work. This should result in a lessening of the danger of a disastrous fire, and this usually means a real money saving by a reduction in the cost of fire insurance. It is, of course, desirable that sketches and plans be submitted to the insurance interests at as early a stage of the work as possible, for any changes which they suggest can be absorbed much more easily before the work has well started. I have known of several cases where the failure to consider the matter of fire protection in the original laying out of water supplies and building plans has either greatly impaired the efficiency of the fire protection or has added unnecessarily to its cost. In a recent case which came to my attention, some two months were spent in preparing a set of sprinkler plans for a large group of buildings. The work was done with more than ordinary care yet a careful study of the plans showed that certain changes were necessary in the arrangement of piping. It then developed that the building had been erected and holes had been left to take the pipes as shown in the plans. Because of the rearrangement it was necessary to fill many of the holes which had been left and to drill others, which as you know is a rather costly procedure in a reinforced concrete building. This trouble would have been avoided had sketches been submitted before the work had progressed so far.

During the remainder of the evening, I am going to take up some elements which enter into the design of buildings which are intended to minimize the fire hazard. Our ideas of such buildings have changed greatly during the last twenty-five years. It was felt at one time that a building which was constructed entirely

of material which would not burn could properly be called fireproof, and presented no fire hazard. We now know that this is but a small part of the problem, and that if a non-combustible building is filled with inflammable contents it resembles a stove with a fire ready to light. The contents will burn if once ignited, and the stove may be seriously damaged if the fire becomes hot enough. The recent destruction of the plant of Thomas A. Edison is a striking example of what fire can do in supposedly fireproof buildings.

In fireproof construction it is well to avoid those materials which are liable to be damaged by heat even if they do not burn themselves. A brick wall is usually to be preferred to one of hollow tile if likely to be exposed to a bad fire, for, while neither will burn, the tile wall may be so badly cracked and broken that it will have to be replaced, while the brick wall would come through practically undamaged. In planning the fireproofing for important steel members, consideration must be given to the possibility of mechanical damage to the fireproofing. Under ordinary conditions 2 in. of cement may afford sufficient insulation to prevent the distortion of important steel beams, but if exposed to a bad fire it is quite possible that this thickness would break or spall quite badly, leaving the steel exposed. For important beams, 4 in. of concrete, well reinforced with wire mesh, is very much better. Similarly, in fireproofing vertical columns, consideration must be given to the possibility of mechanical damage. In a storehouse the fireproofing should be well protected on the outside, to prevent damage from passing hand trucks.

One method of reducing fire damage is to establish strong physical barriers to confine the incipient fire so it cannot assume large proportions. This can be done by dividing a building into sections by means of fire walls. Such walls, as their name implies, are sufficiently heavy to prevent a fire on one side from reaching the other. It is evidently necessary for a fire wall to be absolutely continuous, that is, we can allow no unprotected openings through it; hence, if at any time it becomes necessary to cut holes to allow the passage of pipes or electric wires or other devices, these openings should be carefully sealed up again that

the wall may be as strong as before. The necessity of such procedure is self-evident. Openings not only defeat the purpose of the wall, but firemen, believing that the wall is solid, may fail to notice a tongue of flame which comes through a small hole until the fire has started on the supposedly safe side of the wall.

It frequently happens, however, that it is necessary to maintain passages through fire walls, and in this case it is necessary to provide a covering which will be as nearly as possible equivalent to that of the wall itself. Such protection is afforded by a pair of standard fire doors, one on either side of the wall. These doors should be carefully fitted and should be absolutely standard in every respect. In other words, they should be labeled fire doors, put up with labeled hardware in accordance with the Rules of the National Board of Fire Underwriters. A pair of fire doors so installed have on many occasions shown themselves fully equal to a brick fire wall, and have held back very bad fires for several hours.

Care should be taken to see that there are no timbers running through the wall, and, if the roof on both sides is of combustible material, the wall should be carried up from three to five feet above the roof to prevent the fire jumping over. Of course, if the roof is not of combustible material, say a cement roof, the need of a parapet disappears.

Of equal if not greater importance is the closing of vertical openings, for the tendency of a fire is to work upward whenever possible. The great danger of stairways, elevator wells and similar vertical openings has been very clearly demonstrated in certain of the apartment-house fires which have occurred in this city during the last year. The danger can be reduced by installing hatches which are normally held open in such a way that they will drop in case of fire to close the opening in the floor and thus prevent an upward draft. Such a method is difficult to follow, however, and the better practice is to place stairways and shafts for passenger and freight elevators, dumb waiters, etc., in fireproof enclosures, all openings to which are closed with fire-resisting doors. A very excellent example of what can be accomplished in this direction is the Hotel Belmont in New York, and it would be worth the time of any of you who have occasion

to stop there to examine the very excellent manner in which fire cut-offs have been introduced.

A stair tower, separated fire wise from the building, has long been recognized as a means of getting people out of the upper stories safely in case of fire. To make this secure, however, it is necessary that all openings into the tower be closed with fire doors, so that people can safely pass floors on which the fire is raging. Not long since, I inspected such a tower in a large hotel. It was of very excellent construction, but every one of the eleven doors opening into it was a light wooden door, tinned only on the inside, which would have yielded after a few minutes exposure so that the tower would serve as a chimney to carry the fire to all the upper floors.

In considering fire protection, considerable thought must be given to the protection against fire occurring in neighboring buildings. This evidently calls for fire-resisting coverings to all openings in the building under consideration. Wire glass set in metal sash affords excellent protection, but has been known to melt out after very severe exposure. For very heavy exposures it should be reinforced with tin-clad shutters which may be closed every night or which may be released by fusible links in the event of the exposure from outside buildings. There is always the possibility of exposure by flames from fire on the lower floors of the building rising on the outside and entering the upper floors. Where there is danger of such exposure, it is well to install wire glass in metal sash, which will ordinarily afford such protection as is required.

When it is expected that an addition will be made to a building in the near future, it is sometimes desirable to make the end of temporary construction such as wood or corrugated iron. Such a temporary end will serve well for a time if it is not likely to be exposed to a bad fire, but if there is any considerable amount of combustible material in the neighborhood a more substantial construction should be used, for a comparatively small fire will completely destroy the end and probably do serious damage to the interior of the structure. I have in mind a large power station which was built with the expectation that it would be enlarged from time to time, so one end was corrugated iron

on a light wood frame. As the station was otherwise of excellent construction, I was much surprised to find a considerable addition to the charge for insurance because of the temporary end. Investigation showed that this charge was made not because of the temporary end itself but because a large wooden platform had been constructed on the outside of the station and was being used for the storage of a great variety of materials. A small house for the storage of oils had also been built on the platform, and as there was more or less leakage that portion of the woodwork had become thoroughly oil soaked. This was, of course, a very serious menace to the station, for a slight fire on the platform would have very quickly destroyed the temporary end, leaving the interior exposed to the flames. Had the rating schedule been strictly applied to this property, the additional cost of fire insurance because of this combination of temporary end and wooden platform would have been very nearly four hundred dollars a year. The station was improved by removing a considerable portion of the combustible storage and the installation of an unusually good supply of fire-fighting apparatus, with the result that the added charge was dropped to approximately one hundred dollars a year, and later was again cut in half.

It often happens that some particular section in a building presents a much greater fire hazard than the rest. Evidently this menaces the entire structure, hence it is often advisable to isolate the hazardous section by a standard fire cut-off, or, if possible, to remove the menace so that the property will take the same insurance rate. A case of this sort which comes to me was an addition to an existing power station. The addition was to be of the very best fireproof construction, but the old portion had a wooden floor, which added materially to the cost of insurance. It was desired to have large openings between the two sections to facilitate operation. Evidently a fire in the old section might do considerable damage in the new, hence the insurance rate for the new section would be considerably higher because of the wooden floor in the old section. This situation was handled by replacing the wooden floor with a concrete floor, making the two risks substantially identical and obtaining a low rate for each.

If a fire has once started, the problem is then to detect and to extinguish it. Of course, the most certain means of detecting fire is for some one to see it, hence it is customary, where considerable values are involved, to employ watchmen who make periodic rounds of the property whenever it is not in operation, to see that all is well. They are often on the lookout for burglars or trespassers, but for our purposes we will consider them only as a protection against fire. The property covered by a watchman is usually provided with a number of clock stations which he is required to visit in turn, at each of which he makes a permanent record of his call. In locating such stations, it is, of course, very desirable to so place them that the man will have to pass through or within sight of all parts of the property.

There are various automatic alarms which depend on the influence of heat for their action, and which are used with considerable success to give warning of an unusual rise in temperature.

It is well to provide some means of extinguishing small fires, say with 3-gal. chemical or Pyrene extinguishers, but if the property is located within the reach of an efficient and regularly organized fire department, it is questionable how far the property is justified in going in providing its own protection. Serious fires have occasionally developed because of failure to call the public department until after the private fire brigade had proved inadequate. There is no question, however, that a large property, or one which is at some distance from the regular department, should equip itself with a good water supply and a good supply of fire hose, nozzles, etc., and it can profitably organize a fire brigade of its own. If this is done, a great deal of time and effort must be put in training the members of the brigade that they will know exactly what to do in case of emergency. There is no time after a fire has started to teach lessons or to try experiments.

One of the best and most efficient means which has yet been devised for detecting and extinguishing a fire is the automatic sprinkler system, with which I presume you are all familiar. With this system, pipes carrying water under pressure are run along the ceilings and are equipped at suitable intervals with orifices sealed with plugs held in place by readily fusible metal. A fire

will, of course, cause a rapid rise in temperature and the heat reaching the fusible link will melt it out, allowing the water to flow and extinguish the fire. Some object to this system because the water will continue to flow until it is shut off. The possibility of such damage can be minimized by the use of an alarm valve, a device which is placed in the supply pipe and which sounds an alarm whenever water flows, thus giving warning of fire and water damage. It is generally felt that the water from the sprinkler heads will probably do less damage than if the fire had been allowed to continue until it was detected and extinguished in the ordinary way. Every serious fire that occurs brings forcibly to the public the benefit of the automatic sprinkler system, and I believe the time is not far distant when it will be required much more generally than at present.

Objection is sometimes made to the precautions I have outlined on the ground that the building will contain no combustible material. Experience has shown that this condition is almost impossible of attainment and, even if we can attain it for the moment, we have no assurance that it can be maintained indefinitely. If the present occupancy does not involve the storage of combustibles, a new tenant may come in whose stock can burn. There is nothing more awkward than to have a fire break out when you have no means of extinguishing it, and for this reason every structure should be designed with the idea that it may at some time contain some combustible material which may get on fire.

There is always a possibility that at some time a part of the space will be used for storage purposes and that this will contain combustible material. I recall visiting a small substation of an electric light and power company which was entirely fireproof and which normally contained no combustible material save a small amount of waste used for wiping and cleaning about the machines, and a barrel of lubricating oil. The waste was stored in standard waste cans and the oil in a standard cabinet. The chance of fire damage was very small indeed. On a later visit, however, I found that a portion of the floor where it had been planned to place an additional machine had been given over to the storage of supplies of another department and was piled with

boxes and crates. Some of the boxes contained fragile articles packed in excelsior. Some of these had been opened, the contents removed and the excelsior left exposed. Of course, this storage was not contemplated when the substation was laid out, but it did materially increase the fire hazard, particularly as the station was protected by only two 3-gal. chemical extinguishers and the nearest hydrant was about 500 ft. distant. Had a match been thrown into this pile, or had a fire from any other portion of the station been carried to it by a gust of wind, it would have been practically impossible to prevent a fire, which would have reached and softened the light steel trusses which supported the roof. The danger was greatly increased by several planks, which were used for a walk when snow was on the ground but which were now stored up among the roof trusses and would have added to the fire had it once started.

Somewhat later, another hazard was introduced in this same station owing to the burning out of an armature of one of the machines. In order to make repairs it was necessary to take the machine apart, and a good deal of wood was used in blocking up while repairs were in progress. Some repairs came packed in excelsior, and both packing cases and excelsior were allowed to lie around while repairs were going on. Furthermore, as the damage was to electric wiring, gasoline torches were used for soldering certain joints, and these naturally introduced further elements of danger, among these being the use of matches and gasoline and the presence of open flames. Fortunately no fire occurred. Normal operation has now been resumed, the combustible storage has been removed, the last machine is now in place, and the substation is once more a very excellent fire risk.

After the building is occupied care should be used to see that conditions do not arise which will make it easy for a fire to start. This, however, is largely a question of good housekeeping and does not ordinarily concern the designing engineer. Among the things which come under this head is the care of the electric wiring, not only to see that the original installation is in accordance with the National Code, but to see that extension cords and temporary connections are maintained in safe condition and not open to the possibilities of short circuit or overheating.

As you know, an electric current flowing through a resistance generates a considerable amount of heat, and there are cases on record where a twisted joint in temporary wiring has developed heat enough to set surrounding material on fire. Among other matters to be looked after are the prohibition of the storage of gasoline and similar material, and the use of gasoline torches and other appliances only when absolutely necessary; the careful storage of readily inflammable material such as waste, excelsior, papers, etc., in such places that they cannot be reached by a carelessly tossed match; the prompt collection of oily waste and its storage in standard waste cans until it can be removed, for we know that oily waste is very liable to spontaneous combustion. Collections of sweepings and other dirt should be at once removed, as they occasionally ignite spontaneously.

I have taken considerable time this evening to speak in a somewhat rambling way on the subject of fire dangers and fire protection. I believe it is a subject with which every engineer can profitably become somewhat familiar, for the laws governing fires and their control are simple and well known. We can no more trifle with fire than we can trifle with the force of gravity. If one link in our chain of fire protection is weak, a fire is certain to find it and the entire chain will break. The public has felt in the past that a bad fire was a misfortune for which no one was to blame. It has now learned that buildings can be constructed in which the danger to life and property by reason of fire will be greatly reduced. The feeling is growing that while a man may take chances with his own property or with things which affect no one but himself, he has no right to take risks which endanger the lives or the employment of others. I believe that before long the engineer or architect who designs a building which permits a repetition of recent disastrous fires will be judged as severely as he who designs a bridge that fails, a dam that goes out or a building that collapses. This changed feeling is well reflected in the following paragraph which recently appeared in the *Iron Age*, commenting on the Edison fire:

" The rapid spread of the fire and the general destruction of the plant were not due to mysterious causes. No accidental combination of circumstances, or weather conditions, or peculiar

hard luck, seems to have had anything to do with the magnitude of the disaster. If the plant could be reproduced to-day identically as it was before the fire, a similar small blaze starting at the same point would undoubtedly cause the whole affair to be repeated. Every one knows that the fact that concrete will not burn does not make every concrete building fireproof. The rules for constructing to prevent the spread of fire have been on record since long before the Edison fire. The lesson taught by this case is the old one of disobedience to known laws."

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PAPERS AND DISCUSSIONS

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DISCUSSION OF THE HYDRO-ELECTRIC POWER PLANT AT THE WACHUSETT DAM, CLINTON, MASS.

By Frederic P. Stearns, Dexter Brackett, H. K. Barrows, W. L. Puffer, Charles M. Allen and Alfred O. Doane.

Mr. Frederic P. Stearns. — There is one thing which occurs to me in connection with this matter. Some twenty years ago, when the question of developing electric power at the Wachusett Dam was first broached, an engineer for whom I have very great respect, in discussing the question with me, said, " Don't do it. Such works are built at a great expense for water-supply purposes, and don't get mixed up with commercial work." That statement may have been made partly in jest and partly in earnest. I believe there are cases where it might be undesirable to develop the water power at a water-works dam, even though the proposition appeared to be a profitable one, by reason of the incidental troubles, political and otherwise, which might be caused thereby.

Under other circumstances, as, for instance, under the conditions prevailing at the Wachusett Dam, I believe it to be expedient to develop the power, both as a source of profit to the water works and on the ground that it is desirable to conserve available energy. Holding this view, at the time the dam was built, the gatehouse below the dam, which would have been necessary in any case, was designed of increased size and in such

a way that it might be available as a house in which to install a power plant.

While the work was under construction, the act of the legislature referred to in the paper made it inexpedient to proceed with the installation of the plant, because it made possible the taxation of a great amount of water-works property which would not have been taxable if the power plant were not built. It would have been possible, under that act, for the taxation to have exceeded the amount of money which could be earned by such a plant.

As a result of that legislation the additional expenditures for providing for the installation of power were unproductive for several years, but with the later legislation, which limited the taxation to practically the cost of installing the power plant, the work of installation was taken up and the works are now, as stated in the paper, in operation with successful results. The Metropolitan District is receiving a fair return from the sale of power and there is the gain to the community resulting from the conservation of energy which would otherwise have been wasted.

The paper gives me much more credit in connection with the power plant than is warranted. I am pleased, however, to have been connected even in a somewhat remote way with a plant which has been so successful, and those more directly connected with it are to be congratulated upon having made it so successful.

Mr. Dexter Brackett. — I can add little to what has already been stated in regard to this particular plant. I do, however, wish to testify that Mr. Frederic P. Stearns is very largely responsible for many of the details, especially those connected with the questions of water supply, which form an important portion of the whole.

Our ability to use, or to utilize in developing power, 98 per cent. of the total quantity of water which passes the dam is due in large measure to the very large storage capacity of the reservoirs, and our ability to draw water for use in the Metropolitan District from either the Wachusett or the Sudbury reservoir, which is below it, at such times as we can do so to the best advantage.

As an indication that the plant at Clinton has been successful it may be stated that the board has recently decided to install a similar plant in Southborough, in order to utilize the fall of the water flowing from the Sudbury reservoir into the Weston aqueduct, and into a reservoir located below the Sudbury Dam, and the project has developed so far that a contract has been made with the Edison Electric Illuminating Company, which has agreed to take for five years all the power which may be developed there. The plans for the plant are now being completed and it is expected that the works will be in operation before October, 1915.

The quantity of energy will be about one half of that developed at Clinton, and the net income probably somewhat less than that proportion, because the cost of operation will be larger in proportion.

The water wheels and generators at the plant at the Sudbury Dam are to be mounted vertically instead of horizontally, as at Clinton, the generators to be of the 3-phase, 60-cycle, alternating current type, generating current at 2 400 volts, which will be transformed to 13 200 volts before delivery to the Edison Company. Three vertical turbines directly connected to generators will be used, two of which will utilize the energy from a fall of about 35 ft. in the water flowing to the Weston Aqueduct, and the third that in a fall of about 60 ft. in the water flowing into Framingham Reservoir No. 3. The estimated cost of the plant is $80 000.

Mr. H. K. Barrows. — This is certainly a case of true conservation by the utilization of a by-product. The plant is primarily for purposes of water supply, and the water power is the by-product. It is interesting as the first example of the kind in this country, if not in the world.

The amount received for the power, I assume from the figures submitted, probably nets the Commonwealth somewhere between $15 000 and $20 000 a year after allowing for fixed annual charges on the power plant. Capitalizing with interest at 4 per cent. it seems like quite a large figure, perhaps four or five hundred thousand dollars. On the other hand, the cost of the entire plant, including dam and reservoir, was about

$11 000 000, for which the annual charges at, say, 5 per cent., would be about $550 000. The return from this power plant, while a fair-sized amount yearly, represents only a small portion of the yearly cost of the whole water supply plant. It is an amount, however, well worth saving.

Another thought occurs in this matter, and that is, To what extent can power development be carried out in other cases? The Metropolitan Water Board are planning a similar installation at one of their other dams, and considering the country as a whole no doubt this can also be done at other plants. It appears that they must of necessity be the large and expensive water supply developments like that for New York City and others of that type, because to develop an amount of power that is worth while requires a fairly large constant flow of water, along with the head which would normally be available at such a reservoir. In this case about 118 square miles of drainage area is utilized, or enough to provide a satisfactory amount of power with the available head of about 90 ft. In the case of water supply for cities and towns of lesser size, in some cases the head would be available, but in general the amount of water to be utilized would be small. This manner of power utilization must of necessity, therefore, be limited to the larger and more expensive water supply plants.

It would be of interest if Professor Allen would include in his discussion some of the curves and results of the tests which he made on these wheels. The specifications called for a test under a head of 90 ft., but it has not been stated what requirements, if any, were made for the performance of the wheels under a greater or less head. It appears that the range is from 80 to 100 ft., and it would be of interest to know what the performance of these wheels would be under this considerable variation in head. The wheels are of modern type in quite general use in the country as a whole. In this immediate vicinity, and in New England generally, there are but few installations as yet of this kind.

Progress in turbine development here in this country has made great strides during the last decade, and the delay in establishing the power plant at Clinton on account of legal

difficulties has at least resulted in a much better plant than could have been installed at the time the dam was constructed.

Prof. William L. Puffer. — I came here to-night as a listener, not having consulted my notebook or prepared anything in the way of looking up the past history of the subject, so that whatever I may say is entirely off-hand and without any consultation with the engineers of the Board.

Knowing as I did the general electrical demand and supply in the vicinity of the Wachusett Dam at the time I was first asked by Mr. Brackett to look into the question, it was self-evident to me that the proposition as it had been advanced up to the time I first knew of it was not a desirable one.

There appeared to be but three possible customers for the output of the proposed plant,— the Lancaster Mills, operating a 600-volt, 40-cycle plant; the Marlboro Electric Company, generating power at 2 300 volts, 60 cycles; and the Connecticut River Transmission Company, distributing 66 000-volt, 60-cycle power of the Connecticut River Power Company.

It so happened that I had tested and accepted the pair of large frequency changers at the Lancaster Mills, which had been designed in accordance with my specifications. These machines take the 13 000-volt, 60-cycle power from the high-tension lines and both reduce it to 575 volts and at the same time change the frequency to 40 cycles for use in the mills. In accordance with the desires of the owners, I had specified that the machines could be so operated as to offset the harmful effects on the transmission line due to the presence of a great many of the motors as used in the mill and about Marlboro.

The use of the frequency changers for this purpose rendered it unnecessary to consider in the design of the Metropolitan power plant anything in the nature either of line voltage regulation or the compensation of low-power factor. I was familiar with the output of the Marlboro Electric Company, which has a very heavy day load of motors of the induction type and also has a very large demand for lighting of the highest class, requiring good service.

The very first duty of mine was to convince the Board that it would be very undesirable to put in a 40-cycle plant, as that

frequency was practically a matter of history and that power could never be sold in the future to any customer than the Lancaster Mills, and that in all probability the Connecticut River Transmission Company would be the ultimate purchaser of the power to be developed. However, there was no trouble in gaining this point.

It was several times necessary to read the riot act both to the people who wanted to buy power and to those who wanted to sell water wheels and governors, because they could not understand the kind of service that would best match the demand for the water that the Metropolitan Board had to supply. No water-wheel manufacturer had apparently contemplated the installation of a water wheel and governor under such conditions that there must be a limit set to the maximum amount of water passing through the wheel, and that this limit must hold irrespective of any fluctuations of the mechanical output of the wheel.

The governor and gates must, when desired, be operating in the usual manner up to this limit, and there could be no such thing as a momentary increase in the maximum amount of water passing. In order that a definite known amount of water be flowing steadily requires that the gates be locked, as it were, at a proper opening, but should there be any accidental reduction of the output of the generator corresponding to this opening, the immediate increase in speed must be checked during the time that the output remains too small.

The limit of output of the plant as a whole is set by the sum of the various gate openings, which is limited and must be equal to the flowing capacity of the aqueduct. The electrical output at this maximum gate opening depends on the height of water in the reservoir.

In the planning of this plant it was known that there must be satisfactory operation at any or all times either with the Connecticut River Transmission Company's lines, or isolated operation with the Marlboro Electric Company or one of the frequency changers as a load or a combination of both. It was known that when the new plant would be operating there might also be power fed into the lines from turbines, gas-engine driven

generators and slow-speed steam engines, yet it was desired that all of the water passing should be efficiently used.

The method of operating should be about as follows: The generators are slowly brought up to the proper speed and voltage and when exactly in step with the line the switches are closed, and the generators are ready to supply "all of the energy that can be developed" from the quantity of water decided upon. The gates are gradually opened and adjusted, the increasing flow of water causes an increase in the torque, and so a balancing electrical output flows to the line, — no more, no less. The gates should be now "blocked" by some mechanical device or by a "steep falling characteristic" at exactly that definite output, yet have an overspeed safety device to move that gate should the load fall off.

As a safeguard, the wheels and generators were tested at an increase of 100 per cent. in speed, during which test the speed rose to 800 revolutions per minute and the voltage from 13 800 to 34 000.

Prof. Charles M. Allen. — At the time the wheels were installed in the hydro-electric station of the Metropolitan Water Works at Clinton, Mass., a brake test was made on one of the units. The generator was temporarily set aside and a special shaft with outboard bearing was installed, upon which was mounted the dynamometer. The dynamometer was so rigged by a system of overhead levers that the weight of the dynamometer was taken off the bearing during test.

The accompanying curves show the results of these tests. It will be noticed that the horse-power curves relative to speed for the various gate openings are flat. This is a good characteristic for wheels which are to operate under varying heads, as is the case in this plant.

Mr. Alfred O. Doane. — The subject has been covered very thoroughly and there is very little left for others to add to it.

There is one point, however, that occurred to me in connection with the plant. A comparatively long time passed after the dam was built before the plant was installed, and that time was not entirely wasted, because it so happened that it

TESTS NOS. 2313 TO 2358 INCL.

ALDEN ABSORPTION DYNAMOMETER

WORCESTER, MASS.

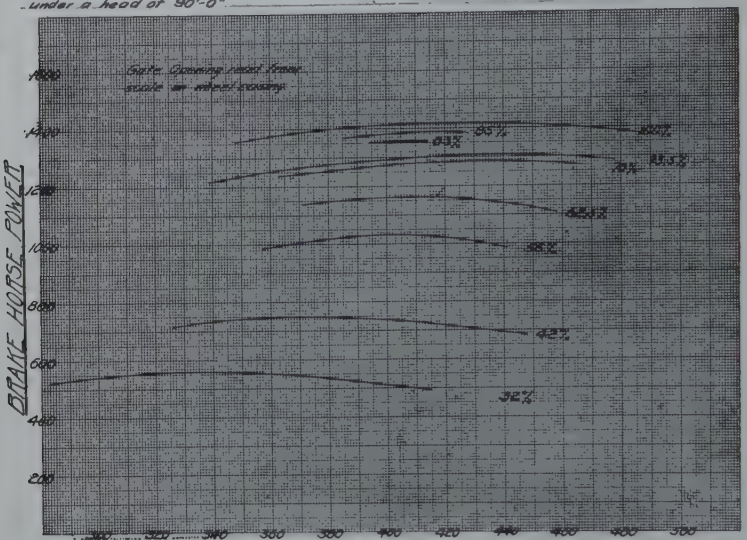
UNIT NO. —

DATE Aug 3-9, 1911

TEST OF L.H. 30" Special Smith Wheel. AT PLANT OF Met. Water & Sewerage Board.

Wheel. MADE BY S. Morgan Smith Co. TESTS MADE FOR —

REMARKS Curves showing relation betw. Horse Power and Speed for various Gate Openings under a head of 90'-0"



SPEED - R.P.M.

TESTS MADE BY C.M. Allen

TESTS NOS. 2313 TO 2358 INCL.

ALDEN ABSORPTION DYNAMOMETER

WORCESTER, MASS.

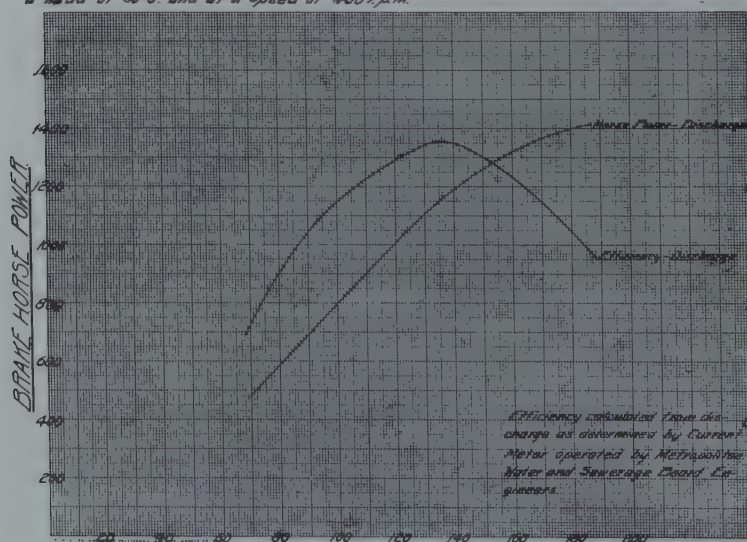
UNIT NO. —

DATE Aug 3-9, 1911

TEST OF L.H. 30" Special Smith Wheel AT PLANT OF Met. Water & Sewerage Board

Wheel MADE BY S. Morgan Smith Co. TESTS MADE FOR —

REMARKS Curves showing relation betw. Horse Power & Discharge (and Efficiency) under a head of 90'-0" and at a speed of 400 r.p.m.



Efficiency computed from discharge as determined by Current Meter operated by Metropolitan Water and Sewerage Board Engineers.

DISCHARGE - C.F.P.S.

TESTS MADE BY C.M. Allen

was about the time when there was very rapid development in the design of water wheels and of the electrical apparatus, so that the Clinton plant as finally installed was of a very different type and character, both on the hydraulic and electric ends, than if it had been put in directly after the dam was finished, and while that brought about some complications in the fitting of this style of plant to the power-house design, which was made up with the idea of the earlier apparatus, it was all a distinct gain because of the higher efficiency and more modern character of the apparatus. The machinery proposed for the Sudbury dam hydro-electric plant which has been spoken of is still further advanced in design, due to the great and increasing demands of hydro-electric propositions. The type of water wheel at the Sudbury dam is very different from that at Clinton. The ones that will probably be used at this place are vertical shaft machines of the so-called American type, which has been so much improved in the last two or three years that they now get Holyoke tests of 90 per cent. efficiency or better.

Prof. Frank B. Sanborn. — It is not just clear to me what the coefficient of the Venturi meter was finally determined to be.

Mr. Allardice. — Owing to the very special type of Venturi meter, the standard formula for computing the flow did not apply, and at the time of the official test of the turbines the meters had not been calibrated. As the demands upon the new plant were urgent, it was decided to use a coefficient of 100 and make observations on a temporary dial on the recorder, which observations could be reduced to true values of flow after the meter had been calibrated. As the velocity of the water entering the scroll case of the turbine was also being measured with a pitometer, it soon became evident that a coefficient of 100 was too high. Therefore, a trial was made with the coefficient value 95, and observations made on the rates of flow. It was found, eventually, that the coefficient for this very special type of meter was a variable with a value of about 98 at the low flow measured, and gradually decreasing to $93\frac{1}{2}$ at the high flow.

Prof. George E. Russell. — What was the reason for this very special design of meter, and was it rated before installation?

MR. ALLARDICE. — Obviously there were but two locations in the penstock lines where a Venturi meter could be installed. One place was in the 48-in. cast-iron pipe portion, and the other in the 84-in. vertical brick-lined well. The distance between the bottom of the vertical well and the lower sluice gate was too short for a 84-in. meter, and the high velocity of the water in the 48-in. cast-iron pipe, about 14 ft. per second, made it impractical to put a 48-in. meter in this portion of the line. Therefore the special design.

The meters were permanently installed and connected with their proper recorders before they were calibrated.

PROFESSOR SANBORN. — Is it true that the wheels were guaranteed to have an efficiency of 82 per cent., while as a matter of fact the official test resulted in an efficiency of 80½ per cent.?

MR. ALLARDICE. — It is. The contractors guaranteed that the average efficiency of the wheels when discharging 73, 122, 138 and 155 sec.-ft. under a net head of 90 ft. at a speed of 400 rev. per min. would be 82 per cent., while the average efficiency as computed from the measurements of the amounts of water discharged as determined by the current meters and the pitometer was 80.5 per cent.

PROFESSOR SANBORN. — Mention has been made of the continuous running of the plant. Do I understand that the plant runs twenty-four hours daily without any interruptions?

MR. ALLARDICE. — The operating contract with the Connecticut River Transmission Company requires us to run the plant sixteen hours a day when requested provided we need the the water in the Metropolitan District. There is provision made whereby we may furnish twenty-four-hour service under the same requirements for water. As a matter of fact, the most of our running is confined to the mill hours, eleven hours a day, and we arrange to send the week's water supply in the 5½–11-hour days, thereby conserving our energy to its utmost.

MR. WILLIAM S. JOHNSON. — I would like to ask if any studies were made toward using this power in the pumping stations near the cities. The Metropolitan system might be its own best customer.

MR. STEARNS. — In answer to Mr. Johnson's question, I

do not know that the use of the power in the Metropolitan pumping stations near Boston has ever been specially considered. At the time when the matter was first taken up, the difficulty of transmitting the electricity such a distance through a populated district precluded the idea of such use. The certainty of continuous operation of such large pumping stations is the important feature, and it would be necessary to maintain an adequate steam plant and a sufficient force to operate it, even if the electricity were transmitted, because the supply might be cut off by accident and would not be continuous in any event, as the plant at the dam must be shut down on occasions to conserve the water. Under such circumstances there would probably not be as large a profit from using the electricity as from selling it, but it may be a matter for future consideration.

The electricity has been carried to the sewerage pumping station in Clinton, where the cost of pumping by electricity is very much less than it formerly was with steam pumps. The continuity of service in this case is provided for under the contract for the sale of electricity, the Connecticut River Transmission Company furnishing the power for the sewerage plant when the power plant at the dam is not in operation.

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PAPERS AND DISCUSSIONS

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DISCUSSION OF THE COMMISSION-MANAGER FORM OF GOVERNMENT.

By John Balch Blood.

Mr. John Balch Blood (*by letter*). — In his description of the commission-manager form of local government as exemplified of Dayton, Mr. Waite has given a very clear view of the essentials. I feel that this form of government should prove a much greater success than any of our forms of local government, barring the town government with its general town meeting, as it is the only form that conforms to the accepted and reiterated principles of good government. I refer to the separation of the powers of government. It was a prime requirement in the principles of our forefathers in their drafting of constitutions that the legislative, executive and judicial functions of government should be separate. Massachusetts, in her constitution adopted June 15, 1780, stated this with extreme care and almost with redundancy in Article XXX as follows:

"Article XXX. In the government of this commonwealth, the legislative department shall never exercise the executive and judicial powers, or either of them: the executive shall never exercise the legislative and judicial powers, or either of them: the judicial shall never exercise the legislative and executive powers, or either of them: to the end it may be a government of laws and not of men."

The town government conforms to this and is generally regarded as a success. The legislative department is the electo-

rate itself, the town meeting. The executive is the Board of Selectmen. These functions are distinct and separate. Compare this with the common municipal governments having a mayor and council. The council is supposed to be the legislative branch, but you will find that it usually divides itself up into committees and does the executive work. Most of the work for a city government is executive. Now note what the result is in this city government of ours. The council legislates as a body and then executes by various committees. Here is the most beautiful scheme whereby a chairman or member of a committee can put through an order in council that will favor the work in his committee or give him opportunity through his committee to help his own interests. Further, the several chairmen of committees will help each other, on the give-and-take principle, with the general result of log-rolling.

The Dayton plan does have this separation absolutely. The electorate by vote chooses a commission which is the legislative body. This commission elects a manager and the manager appoints the various directors of the executive departments. The executive and legislative departments are absolutely separate and only connected by the provision of original election of manager (elected to serve during good behavior, like Massachusetts judges), and also the provision of recall by the commission and by the electorate. This is the point of paramount success of this form of government, while I see ultimate failure for the ordinary commission form, where the commission is both executive and legislative at once.

The ordinary commission form is likely to stay clean for a while on account of interest, and good unimpeachable men will be chosen. But if the old city government with mayor, veto and cumbersome double chamber was a good instrument for log-rolling, how much more so will be the commission form where the legislative body consists of the five or six executive heads of departments. It will take a pretty strong man to oppose legislation demanded by another executive head. He knows he may sometime want legislative support for his own department.

Personally I believe that the legislative body should be

larger than provided in the Dayton charter; and by inverted approval, and executive temporary orders, have the necessary meetings as few as possible.

Mr. Waite says that "the success of any form of government must ultimately depend on the people." I feel that the direct conclusion from such principle is that the people should be as close to the legislative department as it is possible by form of government to make it. In order to insure that the representative citizens take their places in the legislative body, such place should not require a burdensome obligation of time and attention.

That legislative department is best which carries forth most accurately the will of the community as a whole. Law-abidingness is a necessary attribute of a civilized community. To have this in its largest and best sense we must have the legislative body commensurate with the community as a whole.

I think we can all wish well for Mr. Waite in his work to show the possibilities of this new form of government and at the same time expect much toward the better ordering of our local governments.

MEMOIRS OF DECEASED MEMBERS.

GEORGE BLINN FRANCIS.*

Died June 9, 1913.

GEORGE BLINN FRANCIS was born at West Hartford, Conn., January 31, 1857. He was a lineal descendant of some of the very earliest settlers in the Connecticut Valley, the son of Blinn and Lucy (Hart) Francis.

After attending the public schools of his native town, and the Hartford High School, from which he was graduated at the age of seventeen years, he went to Providence, where he took a position as a student in the Engineering Corps during the construction of the Pettaconsett Pumping Station.

In March, 1877, he was transferred to the City Engineer's Department, which had just been consolidated with the Water

* Memoir prepared by John W. Ellis and Edwin J. Beugler.

Works, where he served for the next four and a half years as assistant engineer, being assigned to the corps in charge of the "Brook Street District" improvements, and, on the completion of that work, to the Water Department.

In 1881, he joined the Engineering Department of the New York, West Shore & Buffalo Railroad, and was assigned to the Ulster Division, in charge of a hydrographic corps between Fort Montgomery — at the southern entrance to the Highlands — and Poughkeepsie; later, he was made assistant engineer in charge of four miles of construction on this division.

Early in 1883, Mr. Francis went to the Pacific Coast with a party selected to make surveys for a relocation of the Oregon Railway and Navigation Company's line between Portland and the Dalles, through the Cascade Mountains. In the spring of that year, he was transferred to Portland as assistant engineer in charge of the construction of a large freight terminal, for the Northern Pacific Terminal Company, on the Willamette River, opposite Portland, including the construction of the car-ferry inclines, in connection with the transfer of passengers, for cars across the river, which were to be built in thirty days in order to be in readiness for the transfer of the famous "Gold Spike" party over the Northern Pacific Railway, in September, 1883.

On the completion of this work he returned East, and for the next two years was employed on general railroad work, — design, construction and maintenance, — including the preparation of plans for harbor works under the direction of the late James B. Eads, M. Am. Soc. C. E., in connection with his scheme for a ship railroad at Tehuantepec, and as assistant engineer, on the Hudson River Division (Weehawken to Albany) of the New York, West Shore & Buffalo Railroad, on maintenance of way.

In the fall of 1884, Mr. Francis resigned the latter position to accept that of engineer of the Portland Construction Company, and as such had charge of the design of warehouses, docks, floating pile-driver, coal pockets, bridges, floating dry-dock, etc. Subsequently he became resident engineer on the construction of the Yakima Division of the Northern Pacific Railroad, returning East on the completion of this work. For the

next three years he served in various positions on general railroad work, both design and construction, as follows: In the Engineer Corps on the Blue Mountain and Kittatinny Mountain Tunnels, on the South Pennsylvania Railroad, at Roxbury, Pa.; with the New Jersey Junction Railway, on field location from Weehawken to Bayonne, afterward having charge of the location and construction through Jersey City; and as division engineer on general railroad work on the Western Division of the New York Central & Hudson River Railroad, with headquarters at Rochester, N. Y.

On May 1, 1887, he returned to Providence, R. I., as principal assistant engineer of the New York, Providence & Boston Railroad, remaining in that position until March, 1892, when he was appointed resident engineer of the New York, Providence & Boston, and Old Colony Railroad Terminal Company (subsequently controlled through lease by the New York, New Haven & Hartford Railroad Company), designing and constructing the Providence Terminal.

On July 1, 1896, he became resident and acting chief engineer of the Boston Terminal Company, designing and constructing the South Terminal Station, in Boston, one of the largest passenger terminals in the world. With such care, foresight and skill were the details of this intricate problem worked out that no important change has ever been made in the layout. The study and experience derived from the successful solution of these two important engineering works led Mr. Francis to specialize in this branch of the profession, in which field he was recognized subsequently as a leading authority.

In the spring of 1899, he designed and supervised the construction of the foundations of the Kingsbridge Power Station of the Third Avenue Railroad, in New York City.

On the completion of the Boston Terminal, he became chief engineer of the Providence Street Railway System, and from February, 1900, to June, 1902, served during a very active period of construction and reconstruction of the Company's urban and interurban lines, building a new generating station, repair shops, car barns, etc.

Mr. Francis resigned to accept a position as head of the

Civil Engineering Department of Westinghouse, Church, Kerr & Company, which company had been retained as engineers in connection with the new Pennsylvania Terminal in Manhattan, and, during the next eight years, the important civil engineering features of this work were under his supervision.

Some other terminal problems which received his attention are: The proposed Union Station at Toronto, Ont.; the proposed passenger and freight terminal at Chicago, for the Chicago and Western Indiana Railroad; the Winnipeg Terminal, Grand Trunk Pacific Railway; Vancouver, B. C., Terminal, Canadian Pacific Railway; the proposed freight terminal, Canadian Pacific Railway, at Toronto; the proposed passenger terminal for the City of Buffalo; the rearrangement of the track layout, St. Louis Terminal; and many smaller terminals, both for passengers and freight, in the United States and Canada. As a member of the Railroad Committee of the Merchants Association of New York City, he rendered valuable assistance in the preparation of its report on "The West Side Improvements," relating to railroad and terminal facilities. He thrice visited Europe for observation and study of the large terminals in England and on the Continent.

Some of the many engineering problems which engaged his attention during his connection with Westinghouse, Church, Kerr & Company were as follows:

Supervision of the construction of two high-speed interurban electric roads, one in the Lackawanna Valley, between Scranton and Wilkesbarre, Pa., and the other in the Ohio Valley between Beaver, Pa., and Steubenville, Ohio; general supervision of the reconnaissance, location and plans for a proposed high-speed electric road between Paterson, N. J., and Times Square, New York City; a proposed electric road between Rochester and Syracuse, N. Y., and a proposed line between Baltimore, Frederick and Hagerstown, Md.; consulting engineer on hydro-electric development for the Atlanta Water and Electric Power Company; consulting engineer, Shut-off Dam, Charles River Basin; consulting engineer, deep foundations, Providence Journal Building; consulting engineer, East Side Easy Grade Street, Providence, R. I.; associate consulting

engineer with Gustav Lindenthal, M. Am. Soc. C. E., on reconstruction of Locust Point Pier for the Baltimore & Ohio Railroad, at Baltimore, Md.; consulting engineer, heavy reinforced concrete bridge, designed for Bush and Gunpowder River Bridges, Pennsylvania Railroad; and investigations and reports on various water-power and irrigation projects in the South and West.

Mr. Francis was a member of the American Society of Civil Engineers, The Institution of Civil Engineers of Great Britain, the Boston Society of Civil Engineers, The Canadian Society of Civil Engineers, the New York Railroad Club and the Boston Engineers' Club.

Mr. Francis joined the Boston Society of Civil Engineers, June 16, 1897. He served as director from March 19, 1902, to March 16, 1904. He was the first non-resident member to be honored with the presidency of this Society, which office he filled from March 17, 1909, to March 16, 1910.

The following papers were read by him before the Society:

March, 1898. — "Providence Railroad Terminals."
February, 1900. — "Construction of the South Terminal Station in Boston."
May, 1902. — "Light Mountain Railways."
January, 1904. — "Timber Crib Foundations" and "Description of the Construction of a Double-track Third-Rail Electric Road between Scranton and Wilkesbarre."
November, 1905. — "Construction of Water Power on the Chattahoochee River at Atlanta, Ga."
April, 1907. — "Pennsylvania Railroad Terminal Station in New York, and the Engineering Problems Connected Therewith."
March, 1909. — "Railroad Terminal Improvements in Providence."

He was awarded a gold medal at the Paris Universal Exposition in 1900, in connection with the exhibit of the Boston Terminal Company; and in 1906, he received the honorary degree of Master of Arts from Brown University.

Mr. Francis was a frequent contributor to the American Society of Civil Engineers, and in 1906 he was awarded the Thomas Fitch Howland Prize by the American Society of Civil

Engineers for a paper on the Scranton Tunnel of the Lackawanna and Wyoming Valley Railroad.

He was also a member of the Masonic fraternity, being a past master of What-Cheer Lodge No. 21; Providence Royal Arch Chapter No. 1; Providence Council No. 1, R. & S. M.; Calvary Commandery No. 13, K. T.; and of Rhode Island Consistory, 32d degree, A. A. S. Rite, N. M. J.

Mr. Francis was one of the ablest railroad and general construction engineers. He had much to do with the development of transportation facilities in the New England and Middle States. He was resourceful and bold in dealing with new problems, and when there was no precedent he never hesitated to create one. The soundness of his judgment was apparent in many difficult undertakings. He had the rare faculty of inspiring others to do their very best, and was always noted for fairness and generosity in dealing with subordinates — some of whom, under his direction, were fitted for places of added responsibility and honor.

His genial disposition, democratic spirit and kindly courtesy won for him the unfailing loyalty, unfeigned affection and unwavering devotion of all who ever worked for or with him. His death is keenly felt by a host of friends and business acquaintances, and is a distinct loss to the profession which he loved, in which his life found its expression, and for which he zealously labored.

Mr. Francis always took a very active interest in this Society, and while he was its President gave very much of his valuable time and thought in the promotion and development of many changes in the conduct of the Society's affairs.

At the first joint dinner of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the Boston Society of Civil Engineers, he made an address in which he suggested the formation of the Engineers' Club of Boston.

In April, 1882, Mr. Francis was married to Florence Louise Greene, of Providence, R. I., who, with one son, George B. Francis, Jr., survives him.

ALBERT H. HOWLAND.*

ALBERT H. HOWLAND was born on February 25, 1845, at Barnstable on Cape Cod, and came of the old stock of New England, being descended from John Howland, a *Mayflower* pilgrim; and he remained owner of the old Howland homestead to the end of his life.

He had the advantage of a good education. He was prepared for college at Amherst Academy, and graduated at Amherst College in 1865, and later received the degree of Master of Arts there. In 1869 he entered the Massachusetts Institute of Technology as a special student and pursued the mathematical and technical studies of the civil engineering course, obtaining the degree of Bachelor of Science in 1871. He took high rank, especially in mathematics, and had an opportunity, which he did not accept, to become an instructor in mathematics at the Institute.

He engaged in the practice of civil engineering in Boston, making a specialty of bridge and roof construction. He was associated for several years with the late Edward S. Philbrick, C.E. After the bridge disaster of December 29, 1876, at Ashtabula, Ohio, he made a valuable examination and study of the wreck; and his report, addressed to the Ohio legislature's committee appointed to investigate it, was printed with the committee's report by the state printers at Columbus, Ohio, in 1877, pages 35–49. Some conclusions, with Mr. Howland's sketch, may be found in the Transactions of the American Society of Civil Engineers, Vol. VI, pages 85, 86 and 196, 198. His principal work was on bridges in the South and the Middle West; and for a time he was connected with a bridge company. Among the structures upon which he was employed are said to have been the roofs of Memorial Hall at Harvard University and the former building of the Boston Young Men's Christian Association at the corner of Boylston and Berkeley streets.

In the latter part of his life he relinquished professional business in great measure. He shared an office with some other gentlemen and had books and periodical publications there and

*Memoir prepared by Frederick Brooks and Frank L. Fuller.

was obliging in supplying information to inquiring friends, being regarded as an encyclopedic source of accurate knowledge. He was, however, quite reticent about his own affairs, of which the persons closest to him were ignorant. He visited regularly on Sundays some of his nearest relatives, who were cousins, and endeared himself to the children as a playfellow. He occupied the same bachelor quarters at 43 Concord Square, Boston, for twenty-six years, but his landlady knew scarcely anything about him. He died there suddenly on April 5, 1914, and the medical examiner found that the heart was affected. Burial was in the family lot at West Barnstable.

Mr. Howland took a deep interest in the Boston Society of Civil Engineers, and was exemplary in faithful attendance for forty years at its meetings and excursions. He occasionally took part in its proceedings, and was keen and skillful in his preparation of material, an example of which may be found in the *Journal of the Association of Engineering Societies*, Vol. IV, pages 12–14, for November, 1884. His watchfulness over the administration of the Society's affairs was useful, even if it sometimes seemed a thankless service; and he had a sense of humor withal. He was a man of sterling integrity and of agreeable disposition, and his loss is felt and deplored by his fellow-members.

LUCIAN A. TAYLOR.*

Lucian Arnold Taylor, the youngest son of Jared and Catharine (Truesdell) Taylor, was born at Harrisville, R. I., on June 20, 1846. The son of a farmer, he passed his early years on his father's farm in Woodstock, Conn., working during the summer and attending school in winter.

In response to President Lincoln's call for men to defend the Union, Mr. Taylor offered his services, but because of his age he was not accepted. But on July 15, 1862, he enlisted in Company B, 18th Connecticut Volunteers, and continued in the

* Memoir prepared by William E. McClintock and Frank E. Hall.

service until the close of the war in 1865. During all this time he was in active service excepting about four months when he was a prisoner of war at Richmond and at home recovering from his severe prison experience.

The two years after leaving the army were passed in Woodstock, working on the farm and at the same time attending the Woodstock Academy.

In 1867 Mr. Taylor moved to Worcester, Mass., where he attended Howe's Business College.

In 1868 he received an appointment as assistant by Phineas Ball, city engineer of Worcester, and started off on what was to be his life's work. He served the city faithfully for fourteen years, during which time he was the engineer in charge of rebuilding the Leicester dam in 1876, of building the Island sewer in 1878–1879, and of building the first Holden dam in 1883. These were works of magnitude and offered obstacles that called not only for engineering skill but for great ability along practical lines. Mr. Taylor met all the demands upon him and developed the traits which later were to make him so successful.

In 1884 he was elected water commissioner, which position he held for one year.

In 1885 he entered the contracting firm of William C. McClellan & Co., of Boston. In 1886, upon the death of his partner, Mr. Taylor bought Mrs. McClellan's interest in the firm, and from that time to his death carried on the business of consulting engineer and contractor.

That Mr. Taylor was successful in his dual capacity as engineer and contractor is evidenced by the large number of important works which he both planned and built. Still further proof of his ability and integrity comes from the fact that he was called in the same capacity to extend works which he built. His boyhood experience on the farm enabled him to accomplish much physically, and his moral qualities made him see clearly the line of demarcation between the duties of engineer and contractor, and he never permitted personal gain to warp his judgment or influence his action. Among the most important works of Mr. Taylor's may be enumerated the water works at Bar Harbor, Kingsfield and Cumberland Mills, Me.; of New-

port, N. H.; of St. Albans and St. Johnsbury, Vt.; of Lynn, Orange, Quincy, Webster, Millbury, Concord, Provincetown and Rutland, Mass.; and of New Haven, New London and Groton, Conn. He devoted most of his time during the past several years to consulting work.

When, in 1913, because of illness, he retired from active work, he was consulting engineer for the city of Lynn and the town of Falmouth, Mass. He also was president of the Millbury, Mass., Water Company, which position he had held for several years.

He retained his residence in Worcester during the twenty-nine years he maintained his Boston office.

His genial personality brought a host of friends. His sterling integrity commanded the respect of everyone who knew him.

Mr. Taylor's death occurred at his home in Worcester on November 19, 1914, after an illness of more than a year, and was caused by a complication of diseases.

He married, on August 29, 1868, Jeannette Arnold, of Putnam, Conn., who with one son and one daughter survives him.

Mr. Taylor was elected a member of the Boston Society of Civil Engineers, September 21, 1887. He also was a member of the American Society of Civil Engineers, the Engineers' Club of Boston, the American Water Works Association, the New England Water Works Association, the Worcester County Society of Engineers, the Worcester County Mechanics Association and George H. Ward Post 10, G. A. R.

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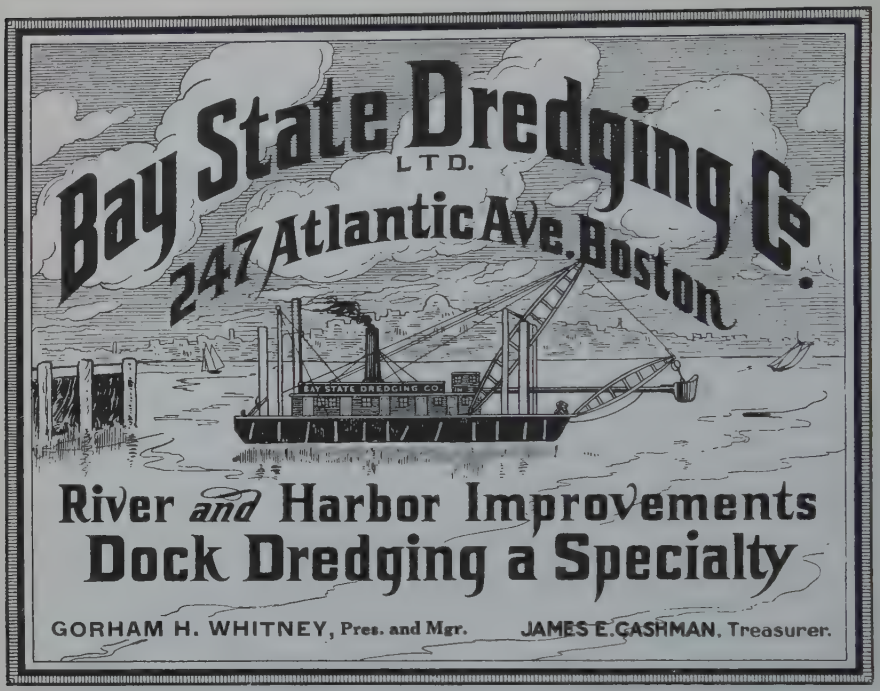

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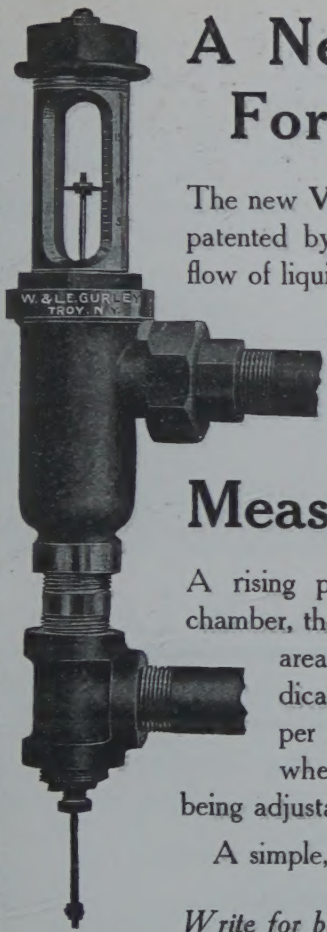

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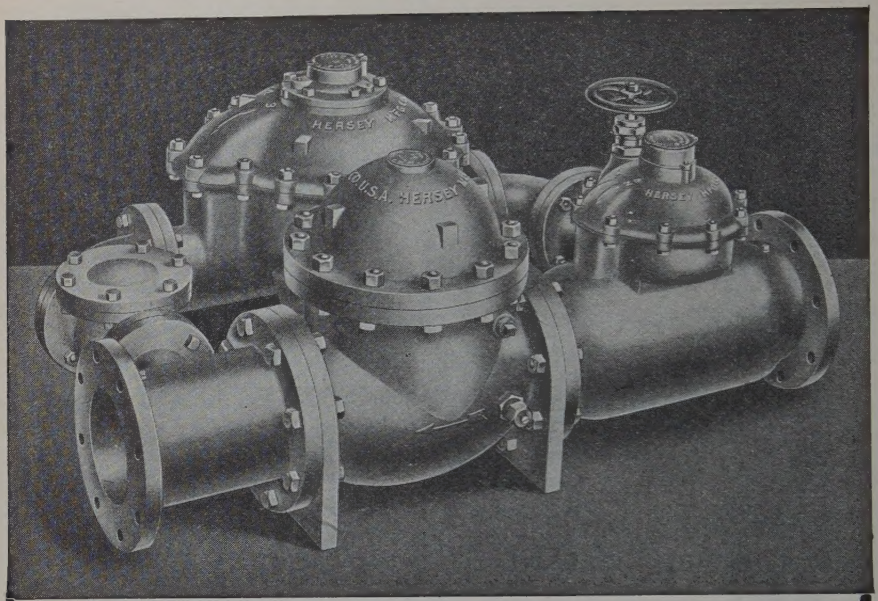

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